

AMENDMENTS TO THE CLAIMS

Claim 1. (Previously Presented) Method for selective separation of each of the constituents of a mixture of synthetic organic materials that are polymers and/or copolymers, intended to be upgraded by recycling, having a density of at least 1, in fragmented form, comprising carrying out their separation by introducing said mixture into a dense liquid medium, which is an aqueous suspension of powder particles dispersed in an adequate amount in an aqueous phase, in order to create a density level chosen as the threshold for separation of the various fragmented synthetic organic materials to be selectively separated by type, wherein said separating suspension is made selective, stable and invariant with regard to density at a precision level of ± 0.0005 with respect to the density level threshold chosen for the selective separation:

a) by the size selection of powder particles having a granulometric cross-section of no more than 5 μm , which solid powder particles thus sized are dispersed and present in an aqueous phase in a sufficient amount to reach the chosen density level threshold, and

b) by the implementation of at least one means of dynamic stabilisation by creating a circulating flow of said separating suspension, which circulating flow is at most 40 m^3/h .

Claim 2. (Previously Presented) Method according to claim 1, wherein the powder particles have a median diameter between 1 μm and 0.005 μm .

Claim 3. (Previously Presented) Method according to claim 1, wherein the powder particles are of natural origin and are selected from the group of powder mineral materials consisting of clays belonging to the families formed by the group of kaolinites, the group of micas, the group of montmorillonites, the group of vermiculites, the group of interstratified clays of which the unitary structure is a combination of the previous groups, the group of fibrous clays, the group formed by calcium carbonate, magnesium carbonate, dolomite, calcium sulphate dihydrate, barium sulphate, talc, alumina, silica, titanium dioxide and zirconium.

Claim 4. (Previously Presented) Method according to claim 1, wherein the powder particles are of synthetic origin and are selected from the group consisting of glass powders, calcium carbonate precipitate and metallic powders.

Claim 5. (Cancelled)

Claim 6. (Previously Presented) Method according to claim 1, wherein the means of dynamic stabilization are selected from the group consisting of agitation by means of an agitation rotor, internal recirculation of the suspension by means of the agitation rotor, external recirculation of the suspension by means of a pump by withdrawing the suspension from the base of the container where it is located and by reinjection into the upper portion of said container, and a combination of means enabling both the agitation by means of an agitation rotor and the internal and/or external recirculation of the suspension.

Claim 7. (Previously Presented) Method according to claim 1, wherein the means of dynamic stabilisation comprise continuous or non-continuous recirculation of the suspension.

Claim 8. (Previously Presented) Method according to claim 1, wherein the circulating flow of the separating suspension is between 5 and 30 m³/h.

Claim 9. (Previously Presented) Method according to claim 1, wherein the circulating flow of the separating suspension is adjusted at an hourly turnover rate of said suspension between 0.5 and 4.

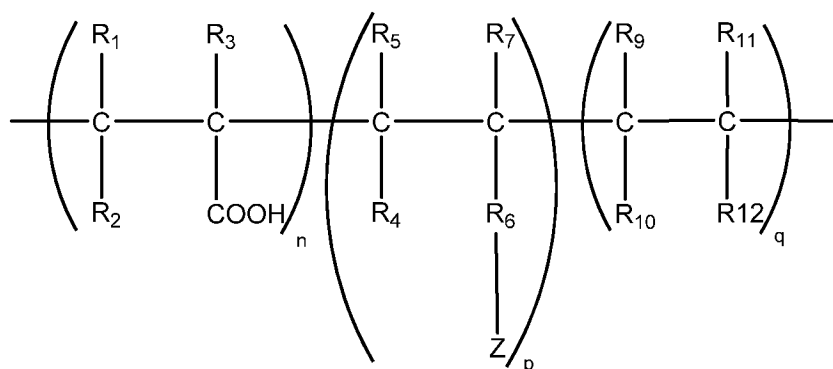
Claim 10. (Previously Presented) Method according to claim 1, wherein the aqueous phase has a conductivity of no more than 50 ms.

Claim 11. (Previously Presented) Method according to claim 1, wherein a water-soluble agent for assisting with the stabilization of the rheological and invariance characteristics of the density level threshold of the solid powder particle suspension is added to said suspension.

Claim 12. (Previously Presented) Method according to claim 11, wherein the water-soluble agent for assisting with the stabilization of the rheological and invariance characteristics of the density level threshold of the solid powder particle suspension is selected from the group consisting of phosphates and polyphosphates, alkylphosphate esters, alkylphosphonate, alkylsulphate, alkylsulfonate, lignin, liginosulfonates in the form of calcium, sodium, iron, chromium, or iron and chromium salts, maleic anhydride and sulfonic styrene acid copolymers,

substituted, neutralised, esterified or non-esterified methylacrylamide and (methyl)acrylic acid copolymers, methylacrylamide-alkyl sulfonic acid and (methyl)acrylamide copolymers, water-soluble acrylic acid polymers used in acid form or, optionally, entirely or partially neutralised by alkaline and/or alkaline-earth agents, by amines and/or salified by monovalent and/or polyvalent ions, and/or esterified, and water-soluble acrylic copolymers having phosphatized, phosphonated, sulfated or sulfonated functions.

Claim 13. (Previously Presented) Method according to claim 11, wherein the water-soluble stabilisation agent is selected from the water-soluble acrylic copolymers, having the general formula:



wherein

- Z is a phosphate, phosphonate, sulfate or sulfonate motif having at least one free acid function,
- n has a value between 0 and 95,
- p has a value between 95 and 5,
- q has a value between 0 and 95,
- the sum of $n + p + q$ is equal to 100,
- R_1 and R_2 can simultaneously be hydrogen, or while one is hydrogen, the other can be a carboxylic function esterified or not by an alcohol in C_1 to C_{12} ,
- R_3 can be hydrogen or an alkyl radical in C_1 to C_{12} ,
- R_4 and R_5 are, simultaneously or not, hydrogen or an alkyl radical in C_1 to C_{12} , a substituted or unsubstituted aryl, a carboxylic function esterified or not by an alcohol in C_1 to C_{12} ,

- R_6 is a radical that establishes the bond between the motif Z and the polymer chain, which radical R_6 can be an alkylene of formula $(CH_2)_r$ in which r can have the values in the interval 1 to 12, an alkylene oxide or polyoxide of formula $(R_8-O)_s$ in which R_8 is an alkylene in C_1 to C_4 and s can have a value from 1 to 30, or a combination of the two formulas $(CH_2)_r$ and $(R_8-O)_s$,
- R_7 is hydrogen or an alkyl radical in C_1 to C_{12} ,
- when $n = 0$, one of R_9 and R_{10} are hydrogen and the other is a carboxylic group, and when $n \neq 0$, R_9 and R_{10} are simultaneously hydrogen, or while one is hydrogen, the other is a carboxylic grouping, an ester in C_1 to C_{12} , an alkyl in C_1 to C_{12} , or an alkylaryl,
- R_{11} is hydrogen, a carboxylic grouping, an alkyl in C_1 to C_3 or a halogen,
- R_{12} is an ester in C_1 to C_{12} , a substituted or unsubstituted amide, an alkyl in C_1 to C_{12} , an aryl in C_5 or C_6 , an alkylaryl, a halogen, a carboxylic grouping or a phosphatized, phosphorylated, sulfated or sulfonated alkyl or aryl grouping.

Claim 14. (Previously Presented) Method according to claim 13, wherein Z comprises a cation, an ammonium grouping, an amine, an alkyl in C_1 to C_3 , a substituted or an unsubstituted aryl in C_3 to C_6 , an alkylaryl, an ester in C_1 to C_{12} , or a substituted amide.

Claim 15. (Previously Presented) Method according to claim 13, wherein, in the sum of $n + p + q$, $n = 0$, when $q > 0$, and $q = 0$ when $n > 0$.

Claim 16. (Previously Presented) Method according to claim 13, wherein R_1 and R_2 are a C_1 to C_4 alcohol esterifying a carboxylic function.

Claim 17. (Previously Presented) Method according to claim 13, wherein R_3 , is a C_1 to C_4 alkyl radical.

Claim 18. (Previously Presented) Method according to claim 13, wherein R_4 and R_5 are C_1 to C_4 alkyl radicals.

Claim 19. (Previously Presented) Method according to claim 13, wherein R_4 and R_5 are C_1 to C_4 alcohols esterifying a carboxylic function.

Claim 20. (Previously Presented) Method according to claim 13, wherein R₇ is a C₁ to C₄ alkyl radical.

Claim 21. (Previously Presented) Method according to claim 13, wherein R₉ and R₁₀ are C₁ to C₃ esters.

Claim 22. (Previously Presented) Method according to claim 13, wherein R₉ and R₁₀ are C₁ to C₃ alkyl.

Claim 23. (Previously Presented) Method according to claim 13, wherein R₁₂ is a C₁ to C₅ ester.

Claim 24. (Previously Presented) Method according to claim 13, wherein R₁₂ is a C₁ to C₃ alkyl.

Claim 25. (Previously Presented) Method according to claim 13, wherein the molecular weight of the water-soluble acrylic copolymers forming the stabilisation agent is from 5000 to 100,000.

Claim 26. (Previously Presented) Method according to claim 13, wherein the water-soluble acrylic copolymers forming the stabilisation agent are at least partially neutralised, by means of a neutralisation agent selected from the group consisting of sodium, potassium, ammonium, calcium and magnesium hydroxides, and primary, secondary and tertiary amines, aliphatic and/or cyclic, mono-, di- and tri-ethanolamines, mono- and diethylamines, cyclohexylamine and methylcyclohexylamine.

Claim 27. (Previously Presented) Method according to claim 11 or 12, wherein the weight of the water-soluble stabilisation agent, expressed as a dry/dry weight percent of said agent with respect to the weight of the powder particles in suspension, is from 0.02 % to 5 %.

Claim 28. (Previously Presented) Method according to claim 1, wherein said method is performed in at least one hydraulic separator equipped with at least one dynamic stabilisation means.

Claim 29. (Previously Presented) Method according to claim 28, wherein when said method is performed in a single hydraulic separator, the chosen density level threshold changes:

- in the increasing direction, by a controlled addition of predefined and selected powder particles to the suspension present in the hydraulic separator, until the new chosen threshold density is reached,

- in the decreasing direction, by adding water until the new chosen threshold density is reached.

Claim 30. (Previously Presented) Method according to claim 29, wherein the change in density of the stable separating suspension, in an increasing or decreasing direction, is carried out under agitation by means of an agitation rotor and/or internal recirculation of the aqueous medium and/or recirculation of the dense medium by withdrawing the dense aqueous medium from the base of the hydraulic separator and reinjecting it into the top portion of said separator of the dense aqueous medium being adjusted.

Claim 31. (Previously Presented) Method according to claim 28, wherein, if said method is performed in a plurality of hydraulic separators, the various separators are placed one after another, in a cascade system functioning with stable suspensions each having a specific density threshold, in an increasing or decreasing order of density.

Claim 32. (Previously Presented) Method according to claim 28, wherein the threshold density level of the aqueous suspension for fine separation is continuously controlled by appropriate measurement means and subjected to an adjustment when any deviation is detected.

Claim 33. (Previously Presented) Method according to claim 32, wherein each hydraulic separator is controlled with regard to the density of the dense medium that each separator contains by means of two electrical valves each opening onto two circuits connected to two tanks, one of the tanks containing a mother suspension with a concentration of about 60% powder particles, stabilised by a water-soluble stabilizing agent, enabling a predetermined amount of the mother suspension to be added, which adjusts upward any deviation toward a reduction in the density of the dense medium for fine separation, and the other tank containing water enabling a predetermined amount to be added so as to adjust downward any deviation toward an increase in the density of the dense medium for fine separation.

Claim 34. (Previously Presented) Method according to claim 33, wherein, in each hydraulic separator, the measurement of the density of the dense medium is performed continuously by at least one measuring apparatus that activates the opening of one or the other of the electrical valves, then the closing thereof when the threshold density level is reached.

Claim 35. (Previously Presented) A method for selective separation of a mixture of polymer materials obtained from the destruction of automobiles and/or durable consumer goods that have reached the end of their serviceable lives comprising implementing the method of claim 1.